NON-PUBLIC?: N
ACCESSION #: 8904240141

LICENSEE EVENT REPORT (LER)

FACILITY NAME: SHEARON HARRIS NUCLEAR POWER PLANT UNIT 1 PAGE: 1 of 9

DOCKET NUMBER: 05000400

TITLE: REACTOR TRIP/TURBINE TRIP ON LOSS OF MAIN FEEDWATER PUMP DUE TO WATER
LEAKAGE INTO THE MOTOR JUNCTION BOX
EVENT DATE: 03/14/89 LER #: 89-006-00 REPORT DATE: 04/12/89

OPERATING MODE: 1 POWER LEVEL: 100

THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR SECTION
50.73(a)(2)(iv)

LICENSEE CONTACT FOR THIS LER:
NAME: G. T. Lew, Project Engineer - Regulatory TELEPHONE: 919 362-2035
Compliance

COMPONENT FAILURE DESCRIPTION:
CAUSE: X SYSTEM: SB COMPONENT: FU MANUFACTURER: B569
X KP FU B569

REPORTABLE TO NPRDS: N
N

SUPPLEMENTAL REPORT EXPECTED: No

ABSTRACT:

The plant was operating at full power producing 890 net MWe on March 14, 1989. Fire Protection Technicians had difficulty in resetting the Fire Protection system deluge valve that supplies the sprinkler system over the Main Feedwater Pumps (MFPs). Their subsequent actions resulted in a small amount of water being sprayed on the "B" MFP. Shortly afterward, an internal short occurred in the motor junction box. The energy from the short blew the door from junction box. The plant controls automatically responded as designed but the reactor tripped on low level in the "A" Steam Generator approximately 71 seconds after the "B" MFP trip. Damage was confined to the motor lead connections and steam plant performance instrument tubing in the

trajectory of the junction box door.

The plant trip was caused by plant design considerations. The shorting of "B" MFP motor lead was due to gaps in the electrical enclosure for the "B" MFP motor that allowed water to enter the junction box. Previous exposure of the junction box internals to water spray caused the deterioration of wiring insulation.

The damage to "B" HFP was repaired and the water tightness of the "A" MFP enclosure corrected. The procedures used by Fire Protection personnel will be revised and applicable personnel retrained. The response of the plant will be reviewed to determine if there are any modifications which would allow a successful runback if a loss of a MFP at high power occurs.

END OF ABSTRACT

EVENT DESCRIPTION:

The plant was operating at full power producing 890 net MWe on March 14, 1989. Fire Protection personnel were troubleshooting a problem with thermal detector I02. This thermal detector is one of eight thermal detectors in the vicinity of the Main Feedwater Pumps (MFPs) and actuate a water spray if high temperatures are detected. Troubleshooting was conducted following the steps of procedure OPT-3209 "Fire Detection Functional Test Local Fire Detection Panel 9." The procedure requires manual isolation of the supply valve, 1FP-408, and local heating of the thermal detector. Acceptance criteria consists of actuation of the solenoid valve (lFP-2117) which actuates the deluge valve and the receipt of proper alarms. The test was completed satisfactorily.

When the alarm was reset and the manual actions to reset the deluge valve performed, the solenoid valve did not reset. As a result, the deluge valve remained unseated and would allow water flow when the manual isolation valve was opened.

Fire Protection personnel could not determine the cause of the failure of the solenoid valve to reset and immediate troubleshooting assistance was not available. They discussed the proper system configuration to minimize the compensatory
ctions necessary for out-of-service sprinklers. The technicians
knew that if the sprinkler heads on the system were "closed" then it would be acceptable to reopen the isolation valve.

They were uncertain of the design of the sprinkler heads. OPT-3209 did not

specify which type of sprinkler heads were installed and the personnel did not consult any other documents to verify system configuration. They decided to open the isolation valve and observe if water sprayed from the sprinkler heads. They obtained permission from the Shift Foreman to proceed in this manner. The personnel assumed that a momentary spray of water would be acceptable because the equipment had been exposed to water spray in the past without any apparent damage. This is a logical conclusion since the motor is designed to be rain tight and is located in an area of the Turbine Building that is exposed to the weather.

Water spray did result. According to an Auxiliary Operator in the vicinity of the "B" MFP, the spray lasted for only 2 or 3 seconds. A subsequent inspection was performed by Fire Protection personnel and the auxiliary operator. The inspection did not reveal any obvious signs of damage to the MFP motor or other equipment in the area. While these personnel were in the immediate area of the "B" MFP, an electrical short occurred in the "B" MFP junction box. The door blew off and damaged some adjacent plant performance instrument tubing but there were no personnel injuries. The "B" MFP breaker opened at 0856:03. Upon observing sparks from the short circuit, the sprinkler water was restarted.

EVENT DESCRIPTION: (continued)

Operators in the Main Control Room immediately received annunciators that indicated a trip of "B" MFP. The operators allowed the automatic control systems for turbine runback, rod control, steam dump, and steam generator water level control to function. These systems functioned as designed: turbine load rapidly decreased to approximately 60%, main feed regulating valves opened fully, steam dump valves opened to limit Reactor Coolant System average temperature (Tave), and control rods inserted at a rapid rate. Reactor power was not decreased in time to prevent a reactor trip on low water level in the Steam Generators. The reactor was automatically tripped by a Low-Low Water Level signal from the "A" Steam Generator at 0857:14.

Both motor driven auxiliary feedwater pumps started on Low-Low Water Level signals from two steam generators. The turbine driven auxiliary feedwater pump was taken out of service prior to the event to perform maintenance. Low feedwater flow tripped the "A" MFP at 0857:40. The operators observed that one steam dump valve (IMS-109) did not fully shut and one condenser dump valve (lMS-107) did not open. Operators shut the Main Steam Isolation Valves to control the decrease in RCS Tave. The plant was stabilized at hot standby.

CAUSE:

The reactor trip was the result of several unrelated conditions that led to the trip on "B" MFP. The causal factors to consider include:

a. Gaps in the "drip proof" housing for the "B" MFP.

b. Previous exposure of the "B" MFP motor to moisture resulted in degraded insulation of the connections in the junction box.

c. Failure of a fuse in the control circuit for the solenoid valve (lFP-2117) which prevent successful resetting of the deluge valve (lFP-2520).

d. Incorrect action by Fire Protection Technicians when 1FP-2520 did not reset properly.

e. Plant design which limits the ability of the plant to sustain a loss of one Main Feedwater Pump at high power levels without a reactor trip.

The relationship of these events is shown in Figure 1. These causal factors are discussed separately below.

Gaps in the "Drip Proof" Enclosure

Figure 2 shows a sketch of the motor enclosure and junction box for the MFPs. The motor enclosure is designed as a NEMA II and the junction box as NEMA III. Both levels of protection provide for a "drip proof" enclosure. The enclosures were inspected and gaps were found where the "feed through assembly" that connects the junction box to the motor enclosure. The connection to the junction box is flanged and several mounting bolts were missing. There is no record of any repairs to this area of the motor and it is presumed that these deficiencies have existed since initial construction.

Exposure of "B" MFP to Moisture

In the past, the "B" MFP has been exposed to short term inadvertent actuation of the Fire Protection Sprinkler System and to nearby water and steam leaks. The most recent occurrence was a leak that could not be isolated in the high pressure seal leak-off line common to both main feedwater pumps. The leak occurred on January 17, 1989, and sprayed the general area with hot water for approximately four hours as the plant was shutdown. A second event occurred on January 31, 1989, and involved a small leak that was repaired while the plant was in service.

The motor and junction box were inspected during the 1988 refueling outage (August-October 1988) and no moisture problems were noted. When the motor and its junction box were inspected after this event, rust was observed in the junction box below the place where the "feed through assembly" was bolted to the junction box. The presence of rust and the gaps show that water entered the enclosures in the past and immediately prior to the motor trip.

The actual location of the short was determined to be the connection between the "B" phase motor lead and the cable internal to the junction box. Lugs on the field run cable and the motor lead are bolted to form a typical connection. The combination is wrapped with insulating material. The connections for all three phases were dissected. Evidence of melting was found in one "B" phase connection. It was concluded that the connector was exposed to water and that water had migrated through the wrapped insulation. Eventually, a path to ground was established. When this path to ground was completed, an electrical short circuit occurred.

Failure of 1FP-2117 to Reset

It was determined that the solenoid valve would not reset as a result of a blown fuse in the control circuit for the valve. No other problems with the circuit were found.

Plant Response to the Loss of "B" MFP The major control systems which responded to the event were in automatic. These systems functioned properly. The reactor trip resulted from the interaction of the Steam Dump Control System, the Rod Control System, and the existing plant conditions. The condenser steam dump valves were modulated open to limit the rise in Tave until the Rod Control System can reduce Tave to within 5 degrees of a new Reference Tave. This reference temperature (Tref) is specified by turbine load. The Rod Control System inserted control rods at the maximum rate. The maximum rate was required because of the sudden large mismatch between turbine load and nuclear power and because of the large mismatch between Tave and Tref.

Opening the Steam Dumps prevents an Overtemperature Delta T Reactor Trip by limiting the rise in Tave. This action creates a large mismatch between steam flow and feedwater flow. This flow deficit causes a decrease in Steam Generator level. The duration and magnitude of the flow deficit is directly related to Control Rod worth and Power Defect. For this event, the Rod Control System was only able to add negative reactivity equal to 20% of Power Defect before the Steam Generator Low-Low water level trip setpoint was reached. The reactor tripped approximately 71 seconds after the trip of the "B" MFP.

A technical evaluation of this event and a similar transient which occurred when the "A" MFP shaft sheared on February 6, 1989, was prepared. The conclusion of that evaluation is that, even with proper operation of the respective control systems, the plant may not survive a loss of one MFP at 100% power without prompt and significant operator action. Procedures to maximize the probability of recovery from the loss of one MFP event are in the process of development and implementation (including operator training). However, power defect increases throughout core life and Control Rod worth remains relatively constant. Therefore, the probability of successful operator action will change with time. A detailed review of plant design and control system interaction is specified as a corrective action.

Equipment Failure During the Transient

Inspection of lMS-109 revealed that the air booster was not working properly due to dirt in the air booster. The air booster was cleaned and the valve stroked successfully.

Inspection of lMS-107 revealed that a fuse had blown in the control circuit for the actuator. The fuse was replaced and the valve stroked successfully.

SAFETY SIGNIFICANCE:

There were no safety consequences as a result of this event. The reactor trip system and other safety systems functioned as required. The initiating event would not have caused a more severe accident at a lower initial power level.

CORRECTIVE ACTIONS:

1. The "A" MFP motor was inspected prior to restart of the plant.

2. Missing bolts on the MFP "feed through assembly" were replaced and the joints were sealed.

3. The "B" MFP was repaired.

4. A blown fuse was replaced in LFDCP 9.

5. Valves lMS-107 and lMS-109 were repaired.

6. A program to investigate the seal and water tightness for electrical connections on other major motors was begun.

7. A routine inspection program will be prepared for use when major electrical components are exposed to unusual amounts of water spray.

8. Procedure enhancements and retraining will be accomplished for the Fire Protection personnel responsible for resetting deluge valves.

9. A review of the plant design will be performed. This review will determine if reactor trip setpoints and control setpoints can be modified to accommodate a loss of one MFP while operating at full power.

10. The conclusions of the study identified in 9 will be incorporated into applicable procedures.

ENERGY INDUSTRY IDENTIFICATION SYSTEM EIIS CODE

System or Component EIIS Code

Auxiliary Feedwater Pump BA

Condenser Dump Valve (lMS-107) SB

Deluge Valve (lFP-2520) KP

Fire Detection Panel KP

Fire Protection Sprinkler KP

Fire Protection System KP

Main Feedwater Pump SJ

Reactor Coolant System AB

Rod Control System JD

Solenoid Valve (IFP-2117) KP

Steam Dump Valve (lMS-109) SB

Steam Generator SB

Turbine TA

EVENT AND CAUSAL FACTOR ANALYSIS FIGURE 1
FIGURE 1 OMITTED - NOT KEYABLE (DRAWING)

FIGURE 2
MAINFEEDWATER PUMP MOTOR/JUNCTION BOX LAYOUT
FIGURE 2 OMITTED - NOT KEYABLE (DRAWING)

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APRIL 13 1989

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U.S. Nuclear Regulatory Commission
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Washington, DC 20555

SHEARON HARRIS NUCLEAR POWER PLANT UNIT 1
DOCKET NO. 50-400
LICENSE NO. NPF-63
LICENSEE EVENT REPORT 89-006-00

Gentlemen:

In accordance with Title 10 to the Code of Federal Regulations, the enclosed Licensee Event Report is submitted. This report fulfills the requirement for a written report within thirty (30) days of a reportable occurrence and is in accordance with the format set forth in NUREG-1022, September 1983.

Very truly yours,

R. B. Richey Manager
Harris Nuclear Project

RBR:tbb

Enclosure

cc: Mr. R. A. Becker (NRR)

Mr. W. H. Bradford (NRC - SHNPP)
Mr. S. D. Ebneter (NRC - RII)

MEM/LER-89-006/1/OSI

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